

FRIENDSHIP LAKE MANAGEMENT PLAN.

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Mail & Call List

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FRIENDSHIP LAKE DISTRICT - MANAGEMENT PLAN

September, 2005

This plan has been prepared by the Friendship Lake District in conjunction with the Department of Natural Resources.

GOALS AND OBJECTIVES

1. To effectively control the quantity and density of nuisance aquatic plant growth and to eradicate Eurasian water milfoil, curly leaf pondweed and other invasive species in Friendship Lake to better facilitate the conduct of water related recreation, improve the aesthetic value of the resource to the community and enhance the resource value of the water body.
2. To manage the impoundment, in an environmentally sound manner, pursuant to the standards and requirements set forth in Administrative Codes NR 103 – Water Quality Standards for Wetlands, NR 109 – Permit for mechanical Harvesting of Aquatic Plants, and NR 107 – Aquatic Plant Management, to vigorously preserve and enhance its water quality and biotic communities, their habitats and essential structure and function in the water body and adjacent areas, as determined through our overall lake management plan.
3. To protect and maintain public health, and promote public comfort, convenience, necessity and welfare, in concert with the natural resource, through the environmentally sound management of native vegetation, fishes and wildlife populations in and around Friendship Lake.
4. To promote a quality, water based experience for residents and visitors to Friendship Lake, consistent with the policies and objectives of the Department of Natural Resources.

BASELINE INFORMATION

Lake Morphometry

Friendship Lake is a 115-acre impoundment located in Adams County. The lake is located within the most populace area of Adams County, namely the Village of Friendship and City of Adams. Friendship Lake's immediate proximity to the population center greatly increases its recreational value. The lake is especially valuable when you consider that central Wisconsin is not as richly blessed as other areas of the state in water resources. Portions of the property around the lake are in the Town of Adams and Town of Preston. Due to its location and easy access, it serves as a major source of recreation for residents and visitors, alike.

Friendship Lake was created by the damming of Little Roche-A-Cri creek. The dam is currently owned by an individual who provides electricity to the local electric grid.

A bathymetric map of Friendship Lake is included in the appendix but generally; the lake is an elongated water body with a maximum depth of 15 feet and an average depth in the 5-8 foot range. Surrounding land is relatively evenly divided between year-round residents and second-homes for people from other parts of Wisconsin and other states. Although located within the most populous area of Adams County, natural beauty abounds with the view of Friendship Mound to the West and the mixed coniferous/deciduous trees and wildlife areas.

Friendship Lake is divided into 2 sections by 11th Avenue, which runs North and South through Adams County. The road crosses the lake at a point locally known as Makovich's Bridge. This is a popular fishing site as it provides about 1/4 mile of shoreline fishing. This section also features a Class I trout stream entering the east end of the lake. The average depth in the East section varies from 1 to 9 feet. An undeveloped access is available and frequently used by smaller boats and canoes. Small boats easily pass through the culvert under 11th Avenue to gain access to the East end.

The West section of the lake varies in depth from 3 to 15 feet. The public access, parking lot, beach and bathhouse on the West section of the lake was renovated and improved in July of 1992 and May of 2003, utilizing funding from the Wisconsin Waterways Commission. Establishment of the Lake District and weed harvesting were the next logical steps to fulfill the lakes recreational potential. A narrow elongated bay runs along the South end of the lake and is heavily developed with permanent and seasonal homes along its North shore. In spring, the South shore receives very heavy pressure from bank fishermen, until the bay becomes so heavily vegetated that fishing becomes impossible.

Shoreline Development

As noted, the shores of Friendship Lake are relatively evenly divided between resident and non-resident homes. The Friendship Lake District will encourage shoreline owners to leave buffer zones of undisturbed vegetation on shore and downed or overhanging trees in the water offshore wherever possible, to slow run-off from rain and snow melt and provide wildlife and fish habitat. It will also be the Lake District policy to discourage the use of fertilizers, pesticides, herbicides or other chemicals in the Friendship Lake watershed area. A significant portion of the South side of the East section of the lake is pasture, woodland and wildlife area. The majority of the East section will remain unharvested because it contains the best habitat for wildlife, waterfowl and furbearers. It also provides excellent spawning and nursery habitat for game fish and pan fish.

A beach and public access (boat launch) are located in the Northwest section of the lake and managed by the Village of Friendship. Public boat access is provided at two additional sites although these are relatively undeveloped at this time. As noted, Makovich's Bridge provides shoreline access to approximately 1/4 mile of bank fishing and is a popular spot throughout the spring and fall months when aquatic vegetation is not so abundant. Shoreline access for bank fishing is also popular off Hillwood Lane where it crosses the elongated bay and the dike on the West end of the lake. A significant amount of ice fishing also occurs during the winter months.

The Lake District will encourage lake residents to implement stormwater management practices.

Water Quality Monitoring

Since 1994, the Wisconsin Self-Help Monitoring Program has been sampling and monitoring Friendship Lake for water clarity, temperature, total phosphorus and chlorophyll. The latest report from the 2003 results of testing shows Friendship Lake to be Eutropic in nature, which suggests a lake of decreased clarity, fewer algae species and an oxygen depleted bottom during the summer with an overgrowth of plants. This is conducive of a warm water fishery (bass, perch, pike, pan fish, etc.). Also, the latest report from the Adams County Land and Water Conservation Dep't., shows Friendship Lake to be in the same Eutropic state.

Aquatic Plants, Distribution and Management Areas

“The 1979 and 1992 plant surveys were not quantitative surveys using the same methods as the 2003 plant study. In the 1979 and 1992, Friendship Lake was divided into 14 areas and qualitative assessments of the plant communities were made within each area. Because of the different methods, direct comparisons can not be made, but some observations can be compared.

The number of species recorded in each survey declined between 1979 and 1992 (18-14) when *Myriophyllum spicatum* was likely introduced and increased slightly between 1992 and 2003 (14-15), when aquatic plant harvesting started (.....).

The disturbance tolerance of the aquatic plant community in Friendship Lake and its closeness to an undisturbed lake changed between 1979 and 2003. The Average Coefficient of Conservatism for Friendship Lake remained in the lowest quartile for all Wisconsin and region lakes (.....), remaining in the group of lakes most tolerant of disturbance. Although the value remained within the lowest quartile, its disturbance tolerance increased from 1979-1992 and decreased slightly from 1979-2003. This suggests that some form of disturbance impacted the lake community during the time the two exotic species (Eurasian water milfoil and curly-leaf pondweed) were introduced and disturbance decreased somewhat (though still some disturbance) during the time aquatic plant harvesting was started.

The Floristic Quality Index of the plant community in Friendship Lake was below average for Wisconsin and region lakes in 1979, dropping to the lowest quartile in 1992 and rebounding somewhat to below the mean again in 2003(.....). This suggests that the plant community in Friendship Lake was farther from an undisturbed condition than the average lake in the state or region in 1979; dropped into the group of lakes farthest from an undisturbed condition during the time period that the two exotic species were introduced; improved to a condition farther from an undisturbed than the average lake during the time that the harvesting program was started.”

The full and complete report, “The Aquatic Plant Community of Friendship Lake, 2003, Adams County, Wisconsin” as issued by the D N R is available through the Lake District or on the DNR website.

As noted in the harvesting plan appendix, harvesting efforts would-be minimized throughout Areas 11, as this section contains excellent habitat for fish and wildlife

Fisheries, Wildlife, and Waterfowl

Friendship Lake is unique in that despite its proximity to the most populous area of the County it is the home to many different types of fish and wildlife.

The lake is a popular fishing area known for its largemouth bass. In addition to largemouth bass, the lake contains bluegill, crappie, pumpkinseed, brook trout, brown trout, perch, northern pike and walleye. The lake offers shoreline fishing at Makovich's Bridge, the elongated bay and the dike located along Highway 13. A steady stream of shore fisherman occupies the banks most weekends. Those fishing include residents, non-residents and young people who are able to ride their bikes to enjoy a day of fishing.

As the East section of the lake is primarily pasture, woodland and wildlife areas, it is the home for ducks, otters, muskrat, and great blue heron. The lake is also a stopping over point for geese, loons and swans during their migrations.

Recreational Uses

Friendship Lake is a multi-purpose body of water serving all forms of recreation, including boating, swimming, skiing and fishing during the summer months as well as ice fishing, ice-skating and snowmobiling during the winter. The beach is also the site for summer swim lessons. Given the location of the lake, it is a popular site for all of these activities.

The Village of Friendship completed a major renovation of the beach and boat launching area in July of 1992. A new beach house with proper changing and washroom facilities, expanded beach area, improved boat launching area, paved parking lot and the addition of a pier were the major improvements. In 2003, a new pier was installed. The community understands that with weed harvesting, the lake has become more usable during all of the summer months.

We will conduct a public users survey to identify important management issues. Surveys and drop boxes will be located at the boat launch for one year. Issues will be incorporated into the Lake Management Plan.

Recreational Facilities

There are two privately owned resorts as well as two restaurants located on Friendship Lake. As noted, there is a public beach and three access sites on the lake. The Village of Friendship also has a park located across from the beach area that is used for picnics, as a playground and for the community's summer volleyball leagues. The lake is located directly off of Highway 13 and local retail outlets exist in very close proximity to the lake. As Friendship Lake is located off a major highway and within the most populous area of the county, it is an important economic resource.

Local Ordinances

The Village of Friendship has an ordinance in effect stating no waterskiing or similar activity is allowed before 10:00 a.m. and after 7:00 p.m.. Otherwise there are no specific ordinances relating to public use of the lake.

We will encourage smart growth planning by participating within town meetings within the Friendship Lake Watershed.

Watershed

We will encourage and hold accountable the Adams County Land & Water Conservation Department to implement the Agricultural Performance Standards. Presently the department is collecting physical, chemical and biological data in the Friendship Lake watershed. It is anticipated that a report showing the results will complete in 2007.

MANAGEMENT OF AQUATIC PLANTS

Use Restrictions Imposed by Aquatic Plants

As previously noted, before Friendship Lake District started harvesting, heavy plant growth restricted the use of Friendship Lake during the summer months. Nine out of the 14 sections were identified on the vegetation map as "typified by solid vegetation." Typically, the only open water, other than sections of the West end, was the channel, which runs throughout the lake. Homeowners on the majority of the lake were unable to get a boat through the thick vegetation to access the open parts of the lake. Boaters using the launch were restricted in their use to those few areas that were navigable. Ascetically, the lake was a most unappealing mass of plants and filamentous algae affecting property values and sales. The problem worsened in each year before the formation of the Lake District. There has been an increase in home sales brought about by the formation of the Lake District

Past and Present Aquatic Plant Management Practices

Unless some sort of plant control strategy continues, the problem will worsen again. There is a winter draw down of approximately 8-10 inches, which provides a slight retardation of growth.

The Friendship Lake Association was formed with the intent of providing weed control. However, the association lacked the funding and personnel to effectively carry out their mission. The association did complete a minor dredging project although the results are not visible due to the abundant plant growth since that time. The Friendship Lake Association considered the alternatives for nuisance plant control but ceased to exist in an active capacity after 1989.

The significant worsening of the lake led to the formation of the Friendship Lake District in March of 1992. Organizers promoted the idea of mechanical control of the weeds through harvesting. Despite the pessimism of some, the organizers obtained the signatures needed. The ability of the organizers to form the district gave credence to the belief that people knew something needed to be done in a systematic, organized manner.

Since its inception, Friendship Lake District has undergone a variety of changes. It started out as an all volunteer district and now while the elected commissioners are still working on a volunteer basis, the weed harvesting is done by paid personnel. This has lead to the district being more selective in how, when, where and what weeds are harvested. This means better fishing, boating, and other recreational activities on the lake as well as a healthier environment for all wildlife living on and in our lake.

Alternative Methods for Aquatic Plant Control

The formation of the Friendship Lake District provided the opportunity for significant change in the appearance of the lake through mechanical harvesting of nuisance plants. Physical methods (such as draw-down) have had short-term effects and will be continued, with the cooperation of the dam owner. The regular use of significant draw downs cannot be completed, as the owner needs to be able to generate electricity when needed. However, the owner of the dam is a supporter of the Lake District and has cooperated to the extent possible.

Chemical controls, though proposed by some, are viewed by the majority as having potential long-term detrimental environmental impacts as well as possible consequences for groundwater contamination. It is also believed to be an expensive solution with no guarantee of success. In addition, with chemicals the plants are not removed but left to recycle as nutrients for next year's vegetation.

Manual methods are also difficult to employ on a large-scale, being the least efficient aquatic plant control method. While manual means are used to control near shore nuisance plants and collect floating materials from mechanical harvesting operations, this method is too inefficient and time-consuming to employ on the scale needed to manage the plant problems in Friendship Lake.

The success of The Friendship Lake District and our neighbor, The Big-Roche-a-Cri Lake District, suggests that mechanical harvesting of nuisance weeds is the only practical and efficient means of controlling plant growth in an environmentally sensitive manner. For these reasons, the use of mechanical harvesting has been chosen by the voters of the Friendship Lake District, year after year, as the management technique of choice.

Mechanical Harvesting

In the spring of 1992, the Lake District purchased its first Aquatic Plant Harvester, after deciding that this method of plant control would be the most cost effective, environmentally sound way of accomplishing its goals. Mechanical harvesting has taken place every summer since then with very good results. Other methods of plant control are discussed almost every year at the annual meetings and mechanical harvesting has been the method approved by the electorate. In 2004, a second harvester was purchased. Both the old and new harvesters are now being used, not to do more harvesting, but to do it more efficiently, since there is not a large enough water path connecting the two lake sections.

AQUATIC PLANT HARVESTING PROPOSAL

Harvesting Plan

The weed-harvesting program on Friendship Lake seeks to improve navigation, remove nutrients and improve aesthetic appearance. Size structure of pan fish populations are also known to improve when vegetation is controlled.

The amount of harvesting will vary from area to area. The complete elimination of weeds in Friendship Lake is not one of our goals. We will harvest plants in the following manner:

1. Heavier removal where nuisance weeds infest the shoreline and extend out into the lake for several hundred feet. Examples of the type of plants which would be removed include coontail, crispus and Eurasian milfoil.
2. Where heavier removal is not desired because of the presence of beneficial plant species such as Lilly pads and large-leaf pondweed, we will minimize harvesting in the large bed areas of these plants to channels for pier access only and "edge effect" for fish habitat.
3. Harvest to a depth of 5 1/2 feet in the deeper sections of the lake so that they can be used by boaters for activities such as sailing or water skiing.
4. Create an "edge effect" in the areas where shoreline fishing is popular including Makovich's Bridge and the Friendship Dam. This "edge effect" is reported to be conducive to maximum fish productivity.
5. Leave sections of vegetation which are reported to be beneficial as fish cover. Again, the use of an "edge effect" will be used to improve fish productivity.
6. Minimize the harvesting of plants on the East end of the lake which provides food and cover for waterfowl and undisturbed spawning and nursery for fish.
7. Harvest the areas around the public beach, boat access and shoreline fishing so that they may be used to the maximum extent possible.

Harvesting will not take place in shallow waters so as to avoid disturbance of fish spawning areas and beds of native aquatic plants, as previously noted. Also special effort will be made to avoid disturbing the spawning and habitat areas of bass in Friendship Lake.

Depth of Harvesting and Treatment of Fragments and Game Fish

The harvester being used has a maximum cutting depth of 5 1/2 feet. Harvesting depth and type of harvesting will be consistent with the goals noted above. All plant cuttings and fragments will be collected by the harvester. Those fragments accumulating along the shoreline areas will be collected by the property owners. Those trained to operate the harvester will be instructed to return all game fish, large pan fish and turtles to the water, whenever possible.

Harvested Plant Material Transfer Site(s)

Off-loading of harvested plant material will take place at 3 sites situated at various sites on the lake. Plant material will be transferred to the trailer using the conveyer system and transported to the disposal site. Plant material will be disposed of when harvested to avoid leaching of nutrients back into the lake and to minimize the negative effect on appearance. The operators will provide minimal interruption at the off-loading sites to people using the lake for recreational purposes.

Disposal of Harvested Plant Material

A local farmer has agreed to accept the harvested plant material and use it for fertilizer after composted. The farm is within 1 1/2 to 3 miles of each of the off-loading sites. Also, a portion of the harvested material is given to the City of Adams to accelerate their composting process.

Precautions to Protect Wildlife Areas

Harvester operators will be provided with a copy of the approved harvesting plan which will be on board at all times and indicates the limits of the harvesting operations. Minimal harvesting will be completed in the upper reaches of the East section of the lake so as to protect bass habitat and spawning areas.

Public Information

In addition to these in-lake rehabilitation methods, an on-going campaign of community information will support the aquatic plant management program by encouraging the use of shore land buffer strips, responsible use of lawn and garden fertilizers and environmentally-friendly household and garden practices to minimize the input of nutrients. The Lake District will use its newsletter to promote these activities based on publications from University Extension and the Department of Natural Resources.

The Friendship Lake District Board is responsible for implementing and updating / revising the Friendship Lake District Lake Management Plan. The Friendship Lake District consists of representatives of lake residents, the Town of Preston and Adams County.

Copies of the Friendship Lake Management Plan have been distributed and are available at the following locations; Friendship Lake District, Town of Preston, WDNR Service Center, Adams Public Library and Adams County Land and Water Conservation Department.

Harvesting Schedule

The harvesting season will begin after May 15 and continue until October 15. If possible, operation of the harvester will not be carried out on weekends to avoid user conflicts. The current Lake District budget provides funding for 70 days of operation. Areas of harvesting may be adjusted if there is a greater need in certain areas based on the goals previously identified. Harvesting will be subject to weather conditions, plant growth and recreational activities. Harvesting will be confined to daylight hours.

In addition, the Lake District, in cooperation with the local DNR, plans to include information in the newsletter based on information from DNR and University Extension pamphlets, such as developing shoreline buffer zones, responsible use of fertilizers and chemicals, erosion control, etc.

Equipment Maintenance

1992 Harvester: Aquarius Systems model H-420

1992 TRC-12 Trailer-Conveyor

2004 Harvester: HM-420 Aquatic Plant Harvester

2004 TR-23 Trailer

The above equipment was purchased from: D & D Products Inc. North Prairie, WI

IH 706 Gas Tractor

The Lake District performs routine maintenance of the harvesting equipment in accordance with the manufacturer's recommendations.

Winter storage of the harvesting equipment is indoors in Adams County.

Insurance Coverage

Insurance coverage on the harvester is the responsibility of the Friendship Lake District. Liability insurance for the operation of the harvester, paid employees, and the volunteers is also the responsibility of the Friendship Lake District.

Operators, Training, and Supervision

The harvesters are the property of the Friendship Lake District. They are operated by a group of paid personnel, and / or trained volunteers. Training and daily supervision are provided by the weed harvester coordinator.

Training may also take place under D.N.R. supervision in the recognition of valuable habitat species or sensitive habitat areas along with invasive species by all new operators and at the beginning of the harvesting season by all other operators.

EVALUATION AND MONITORING

Daily Record-Keeping Relating to the Harvesting Operation

Daily harvesting operation activities will be recorded by the operator in a harvester operations log. An annual summary of the harvesting program will be submitted to the local DNR, by the Lake District, and will be made available to the public at the annual meeting. The harvesting program is considered flexible and if harvesting is found to be either detrimental or ineffective, the harvesting plan will be renegotiated with the Department of Natural Resources.

Daily Record-Keeping Relating to the Harvester

Daily maintenance and service records, including engine hours, fuel consumed, cutting hours and transportation will be recorded in a harvester operations log.

Executive Summary

Friendship Lake is a mesotrophic lake with fair water quality and clarity. Filamentous algae is abundant, especially in the 1.5 – 5 foot depth zone.

The aquatic plant community colonized more than three quarters of the littoral zone to a maximum depth of 10.5 feet, with the most abundant plant growth in the 1.5 – 5 foot depth zone. The community is also characterized by average quality, good species diversity, an above average tolerance to disturbance and a serious lack of emergent plant growth.

Vallisneria Americana is the dominant species within the plant community, especially in the 1.5 – 10 foot depth zone. *Elodea Canadensis* was sub-dominant, especially in the 0 – 1.5 foot depth zone.

A healthy aquatic plant community is important because it can improve water quality, provide valuable habitat resources for fish and wildlife, resist the spread of non-native species and check excessive growth of tolerant species that could crowd out the more sensitive species, thus reducing diversity.

Management Recommendations

- 1) Lake District to continue monitoring water quality in Friendship Lake through the Self– Help Volunteer Lake Monitoring Program.
- 2) DNR should designate sensitive areas within Friendship Lake.
- 3) Chemical treatments for plant growth are not recommended in Friendship Lake
- 4) Encourage lake residents to restore natural shoreline around Friendship Lake.
- 5) Encourage the establishment of emergent plant beds for habitat and to stabilize the shore.
- 6) Lake District and DNR revise the harvesting plan to avoid beds of Lily pads and large-leaf pondweed and to target Eurasian water milfoil and common waterweed.

Enclosed is a map approximating the type of harvesting program that the DNR considers best for Friendship Lake.

Sites A – The two sites labeled “A” are areas in which wild celery (*Vallisneria*) is becoming dominant. Since harvesting wild celery encourages its growth (its growth mechanism is like grass) these areas should be harvested only when residents have nuisance levels at the end of their docks.

Site B is that area in which Eurasian water milfoil was most often recorded and it appears that mechanical harvesting is keeping the milfoil in check. This area of the lake is not the deep end and not suited to high speed boat traffic and is best suited to fishing and other slower recreation. This area would be cut only with navigation channels similar to that shown on the map, avoiding the large – leaf pondweed and Lily pad beds. However, to prevent the milfoil from becoming dominant, cuttings can be made wherever Eurasian water milfoil comes to or near the surface.

Site C is the shallow end of the lake on the East side of the road. This area would only be cut with channels that allow residents access to the other side of the lake and channels for fishing access.

The remainder of the lake should be cut with channels as approximated on the map, to allow resident access and fishing access as needed.

Appendix I, Friendship Lake - 2003

Aquatic Plant Frequency Spreadsheet

| | Total | Occurrence | Occurrence | Occurrence | Occurrence | %Freq. | %Freq. | Relative | Freq. | Freq. | Freq. | Freq. |
|---------------------------|--------|------------|------------|------------|------------|--------|--------|----------|-------|-------|-------|-------|
| Species | Occur. | DepthZone1 | DepthZone2 | DepthZone3 | DepthZone4 | | w.veg. | Freq. | Zone1 | Zone2 | Zone3 | Zone4 |
| Ceratophyllum demersum | 29.00 | 9.00 | 11.00 | 6.00 | 3.00 | 48.3% | 58% | 0.19 | 47.4% | 57.9% | 42.9% | 37.5% |
| Elodea canadensis | 30.00 | 9.00 | 13.00 | 7.00 | 1.00 | 50.0% | 60% | 0.19 | 47.4% | 68.4% | 50.0% | 12.5% |
| Lemna minor | 5.00 | 3.00 | 2.00 | | | 8.3% | 10% | 0.03 | 15.8% | 10.5% | | |
| Myriophyllum sibiricum | 3.00 | | 3.00 | | | 5.0% | 6% | 0.02 | | 15.8% | | |
| Myriophyllum spicatum | 8.00 | 5.00 | | 3.00 | | 13.3% | 16% | 0.05 | 26.3% | | 21.4% | |
| Najas flexilis | 3.00 | 3.00 | | | | 5.0% | 6% | 0.02 | 15.8% | | | |
| Nymphaea odorata | 5.00 | 2.00 | 3.00 | | | 8.3% | 10% | 0.03 | 10.5% | 15.8% | | |
| Potamogeton amplifolius | 2.00 | | | 2.00 | | 3.3% | 4% | 0.01 | | | 14.3% | |
| Potamogeton crispus | 7.00 | 1.00 | 4.00 | 2.00 | | 11.7% | 14% | 0.05 | 5.3% | 21.1% | 14.3% | |
| Potamogeton natans | 3.00 | 2.00 | 1.00 | | | 5.0% | 6% | 0.02 | 10.5% | 5.3% | | |
| Potamogeton pusillus | 9.00 | 4.00 | 5.00 | | | 15.0% | 18% | 0.06 | 21.1% | 26.3% | | |
| Potamogeton zosteriformis | 6.00 | 1.00 | 1.00 | 3.00 | 1.00 | 10.0% | 12% | 0.04 | 5.3% | 5.3% | 21.4% | 12.5% |
| Ranunculus longirostris | 1.00 | 1.00 | | | | 1.7% | 2% | 0.01 | 5.3% | | | |
| Vallisneria americana | 34.00 | 8.00 | 14.00 | 12.00 | | 56.7% | 68% | 0.22 | 42.1% | 73.7% | 85.7% | |
| Zosterella dubia | 9.00 | 3.00 | 3.00 | 2.00 | 1.00 | 15.0% | 18% | 0.06 | 15.8% | 15.8% | 14.3% | 12.5% |
| Totals | 154.00 | 51.00 | 60.00 | 37.00 | 6.00 | 256.7% | | 1.00 | | | | |

| | |
|---------------------|-------|
| Number sample sites | 60.00 |
| Samples not veg | 10.00 |
| Number vegn sites | 50.00 |
| %Veg | 83.3% |

Simpson's Diversity 0.86

| | |
|-------------|-------|
| Zone1 sites | 19.00 |
| Zone2 sites | 19.00 |
| Zone3 sites | 14.00 |
| Zone4 sites | 8.00 |

| | | | |
|----------------------------|----|----------------|-------|
| Sample sites/emergents | | %Emergents | |
| Sample sites/free-floating | 47 | %Free-floating | 78.3% |
| Sample sites/submergents | 29 | %Submergents | 48.3% |
| Sample sites/floating-leaf | 5 | %Floating-leaf | 8.3% |

Appendix II, Friendship Lake 2003

Aquatic Plant Density Spreadsheet

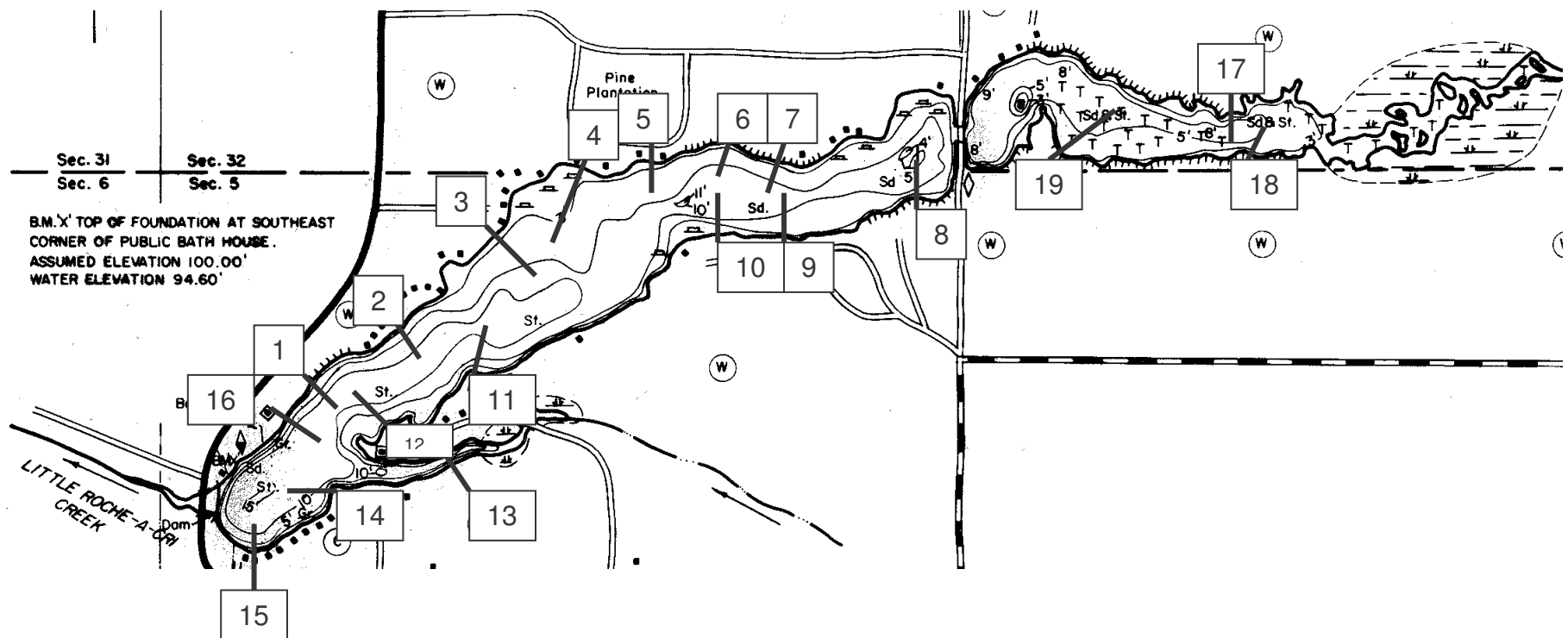
| Species | Total Density | Density DepthZone1 | Density DepthZone2 | Density DepthZone3 | Density DepthZone4 | Mean Density | Mean w.pres. | Dens.Relative Density | Density Zone1 | Density Zone2 | Density Zone3 | Density Zone4 |
|---------------------------|------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------|-----------------|--------------------------|------------------|------------------|------------------|------------------|
| Ceratophyllum demersum | 64.00 | 21.00 | 22.00 | 16.00 | 5.00 | 1.07 | 2.21 | 0.19 | 1.11 | 1.16 | 1.14 | 0.63 |
| Elodea canadensis | 77.00 | 25.00 | 34.00 | 17.00 | 1.00 | 1.28 | 2.57 | 0.23 | 1.32 | 1.79 | 1.21 | 0.13 |
| Lemna minor | 10.00 | 7.00 | 3.00 | | | 0.17 | 2.00 | 0.03 | 0.37 | 0.16 | | |
| Myriophyllum sibiricum | 3.00 | | 3.00 | | | 0.05 | 1.00 | 0.01 | | 0.16 | | |
| Myriophyllum spicatum | 12.00 | 6.00 | | 6.00 | | 0.20 | 1.50 | 0.04 | 0.32 | | 0.43 | |
| Najas flexilis | 5.00 | 5.00 | | | | 0.08 | 1.67 | 0.01 | 0.26 | | | |
| Nymphaea odorata | 8.00 | 5.00 | 3.00 | | | 0.13 | 1.60 | 0.02 | 0.26 | 0.16 | | |
| Potamogeton amplifolius | 4.00 | | | 4.00 | | 0.07 | 2.00 | 0.01 | | | 0.29 | |
| Potamogeton crispus | 12.00 | 1.00 | 8.00 | 3.00 | | 0.20 | 1.71 | 0.04 | 0.05 | 0.42 | 0.21 | |
| Potamogeton natans | 6.00 | 5.00 | 1.00 | | | 0.10 | 2.00 | 0.02 | 0.26 | 0.05 | | |
| Potamogeton pusillus | 18.00 | 7.00 | 11.00 | | | 0.30 | 2.00 | 0.05 | 0.37 | 0.58 | | |
| Potamogeton zosteriformis | 7.00 | 1.00 | 1.00 | 4.00 | 1.00 | 0.12 | 1.17 | 0.02 | 0.05 | 0.05 | 0.29 | 0.13 |
| Ranunculus longirostris | 1.00 | 1.00 | | | | 0.02 | 1.00 | 0.00 | 0.05 | | | |
| Vallisneria americana | 99.00 | 17.00 | 50.00 | 32.00 | | 1.65 | 2.91 | 0.29 | 0.89 | 2.63 | 2.29 | |
| Zosterella dubia | 15.00 | 5.00 | 4.00 | 5.00 | 1.00 | 0.25 | 1.67 | 0.04 | 0.26 | 0.21 | 0.36 | 0.13 |
| Totals | 341.00 | 106.00 | 140.00 | 87.00 | 8.00 | 5.68 | | 1.00 | | | | |

Appendix III, Friendship Lake 2003

Aquatic Plant Dominance Values

| Species | Dominance Value |
|---------------------------|--------------------|
| Ceratophyllum demersum | 0.38 |
| Elodea canadensis | 0.42 |
| Lemna minor | 0.06 |
| Myriophyllum sibiricum | 0.03 |
| Myriophyllum spicatum | 0.09 |
| Najas flexilis | 0.03 |
| Nymphaea odorata | 0.06 |
| Potamogeton amplifolius | 0.02 |
| Potamogeton crispus | 0.08 |
| Potamogeton natans | 0.04 |
| Potamogeton pusillus | 0.11 |
| Potamogeton zosteriformis | 0.06 |
| Ranunculus longirostris | 0.01 |
| Vallisneria americana | 0.51 |
| Zosterella dubia | 0.10 |
| Total | 2.00 |

Appendix IV. Transect Locations on Friendship Lake, 2003 Macrophyte Study



Appendix V. Change in Species Composition, 1979-2003, in Areas Delineated in 1979-1992 Qualitative Aquatic Plant Assessment

| | <u>1979</u> | <u>Area 1</u> | <u>1992</u> | <u>2003</u> |
|---------------------------|-------------|---------------|-------------|-------------|
| Ceratophyllum | | | abundant | common |
| Lemna | | | | present |
| Myriophyllum sibiricum | | | present | |
| Nymphaea | present | | present | |
| Potamogeton zosteriformis | | | present | |
| Vallisneria | present | | abundant | common |
| Filamentous algae mats | | | | present |

| | <u>1979</u> | <u>Area 2</u> | <u>1992</u> | <u>2003</u> |
|------------------------|-------------|---------------|-----------------|-------------|
| Asclepias | present | | | |
| Ceratophyllum | rare | | common-abundant | present |
| Iris | present | | | |
| Myriophyllum sibiricum | present | | present | |
| M. spicatum | | | present | |
| Najas | present | | | |
| Nymphaea | present | | | rare |
| Potamogeton crispus | | | present | |
| P. pusillus | | | | rare |
| P. zosteriformis | common | | common-abundant | rare |
| Vallisneria | abundant | | abundant | common |
| Filamentous algae mats | | | | present |

| | <u>1979</u> | <u>Area 3</u> | <u>1992</u> | <u>2003</u> |
|-------------------------|-------------|---------------|-------------|-------------|
| Asclepias | common | | | |
| Ceratophyllum | abundant | | abundant | present |
| Elodea | | | | present |
| Iris | common | | | |
| Myriophyllum sibiricum | abundant | | common | |
| M. spicatum | | | common | |
| Najas | common | | | rare |
| Nymphaea | common | | abundant | common |
| Potamogeton amplifolius | | | abundant | rare |
| P. crispus | | | common | present |
| P. pusillus | | | | common |
| P. zosteriformis | present | | common | rare |
| Ranunculus | | | | rare |
| Typha | | | common | |
| Utricularia | | | present | |
| Vallisneria | common | | abundant | common |
| Zosterella | | | | present |
| Filamentous algae mats | present | | common | present |

| | <u>Area 4</u> | | |
|-------------------------|---------------|-------------|-------------|
| | <u>1979</u> | <u>1992</u> | <u>2003</u> |
| Ceratophyllum | present | abundant | present |
| Elodea | | | present |
| Myriophyllum sibiricum | abundant | | |
| M. spicatum | | common | |
| Najas | | | rare |
| Nymphaea | present | abundant | |
| Potamogeton amplifolius | present | common | |
| P. crispus | | | present |
| P. pusillus | | | present |
| P. zosteriformis | abundant | common | |
| Vallisneria | abundant | abundant | common |
| Filamentous algae mats | | | present |

| | <u>Area 5</u> | | |
|-------------------------|---------------|-----------------|-------------|
| | <u>1979</u> | <u>1992</u> | <u>2003</u> |
| Ceratophyllum | | abundant | present |
| Elodea | | present | present |
| Myriophyllum sibiricum | common | common | |
| M. spicatum | | common-abundant | |
| Nymphaea | common | common | |
| Potamogeton amplifolius | | present | |
| P. crispus | | present | present |
| P. pusillus | | | present |
| P. zosteriformis | present | present | |
| Vallisneria | abundant | abundant | common |
| Filamentous algae mats | | abundant | present |

| | <u>Area 6</u> | | |
|-------------------------|---------------|-----------------|-------------|
| | <u>1979</u> | <u>1992</u> | <u>2003</u> |
| Ceratophyllum | | abundant | |
| Elodea | | present | rare |
| Myriophyllum sibiricum | abundant | common | present |
| M. spicatum | | common-abundant | |
| Najas | common | | |
| Nymphaea | abundant | common | |
| Potamogeton amplifolius | | present | |
| P. crispus | | present | present |
| P. pusillus | | | present |
| P. zosteriformis | common | | |
| Vallisneria | abundant | abundant | common |
| Filamentous algae mats | | | present |

| | <u>Area 7</u> | | |
|-------------------------|---------------|-----------------|-------------|
| | <u>1979</u> | <u>1992</u> | <u>2003</u> |
| Ceratophyllum | rare | abundant | |
| Elodea | | | rare |
| Lemna | present | | |
| Myriophyllum sibiricum | present | present | present |
| M. spicatum | | common-abundant | |
| Najas | present | | |
| Nymphaea | present | abundant | |
| Potamogeton amplifolius | | present | |
| P. crispus | | present | present |
| P. pusillus | | | present |
| P. zosteriformis | present | common | |
| Vallisneria | common | abundant | common |
| Filamentous algae mats | | | present |

| | <u>Area 9</u> | | |
|-------------------------|---------------|-----------------|-------------|
| | <u>1979</u> | <u>1992</u> | <u>2003</u> |
| Ceratophyllum | abundant | abundant | common |
| Elodea | | present | common |
| Lemna | present | common-abundant | rare |
| Myriophyllum sibiricum | present | present | |
| M. spicatum | | common-abundant | present |
| Najas | abundant | | |
| Nymphaea | abundant | abundant | rare |
| Potamogeton amplifolius | present | common | common |
| P. crispus | | common-abundant | rare |
| P. pusillus | | | present |
| P. zosteriformis | present | abundant | rare |
| Vallisneria | common | abundant | abundant |
| Filamentous algae mats | abundant | common-abundant | common |

| | <u>Area 10</u> | | |
|-------------------------|----------------|-----------------|-------------|
| | <u>1979</u> | <u>1992</u> | <u>2003</u> |
| Ceratophyllum | present | abundant | present |
| Elodea | | common | present |
| Lemna | | common | present |
| Myriophyllum sibiricum | common | present | |
| M. spicatum | | common | rare |
| Najas | abundant | | |
| Nymphaea | present | common | |
| Potamogeton amplifolius | present | abundant | present |
| P. crispus | | present | |
| P. natans | present | | |
| P. zosteriformis | present | abundant | rare |
| Ranunculus | | present | |
| Vallisneria | present | abundant | present |
| Zosterella | | | common |
| Filamentous algae mats | common | common-abundant | common |

| | <u>Area 11</u> | | |
|-------------------------|----------------|-----------------|-------------|
| | <u>1979</u> | <u>1992</u> | <u>2003</u> |
| Carex | present | | |
| Ceratophyllum | common | abundant | abundant |
| Elodea | | abundant | common |
| Lemna | present | abundant | rare |
| Myriophyllum sibiricum | present | present | |
| M. spicatum | | abundant | common |
| Najas | present | | |
| Nymphaea | common | common | rare |
| Potamogeton amplifolius | | abundant | present |
| P. crispus | | common-abundant | |
| P. natans | common | | present |
| P. pusillus | | | rare |
| P. zosteriformis | present | abundant | |
| Ranunculus | | abundant | |
| Sagittaria | present | | |
| Scirpus | present | | |
| Sparganium | present | | |
| Zosterella | present | | |
| Filamentous algae mats | | abundant | present |

| | <u>Area 12</u> | | |
|-------------------------|----------------|-----------------|-------------|
| | <u>1979</u> | <u>1992</u> | <u>2003</u> |
| Carex | abundant | | |
| Ceratophyllum | present | abundant | common |
| Elodea | | common | common |
| Lemna | present | common-abundant | |
| Myriophyllum sibiricum | common | present | |
| M. spicatum | | common | common |
| Najas | abundant | | present |
| Nymphaea | abundant | | common |
| Potamogeton amplifolius | | abundant | |
| P. crispus | | | rare |
| P. pusillus | | | rare |
| P. zosteriformis | present | common-abundant | present |
| Scirpus | abundant | | |
| Typha | abundant | | |
| Vallisneria | abundant | | common |
| Zosterella | | | present |
| Filamentous algae mats | common | abundant | abundant |

| | | <u>Area 13</u> | |
|-------------------------|-------------|-----------------|-------------|
| | <u>1979</u> | <u>1992</u> | <u>2003</u> |
| Ceratophyllum | | abundant | present |
| Elodea | | common | common |
| Lemna | | abundant | present |
| Myriophyllum sibiricum | present | common | present |
| M. spicatum | | common-abundant | present |
| Najas | abundant | | present |
| Nymphaea | abundant | abundant | present |
| Potamogeton amplifolius | | present | |
| P. crispus | | common-abundant | rare |
| P. zosteriformis | common | present | rare |
| Vallisneria | abundant | abundant | common |
| Zosterella | | | present |
| Filamentous algae mats | | abundant | present |

| | | <u>Area 14</u> | |
|-------------------------|-------------|-----------------|-----------------|
| | <u>1979</u> | <u>1992</u> | <u>2003</u> |
| Ceratophyllum | present | abundant | present |
| Myriophyllum sibiricum | abundant | | |
| M. spicatum | | common-abundant | |
| Nymphaea | common | common | |
| Potamogeton amplifolius | | present | |
| P. crispus | | common | |
| P. zosteriformis | common | present | |
| Vallisneria | abundant | abundant | common-abundant |